

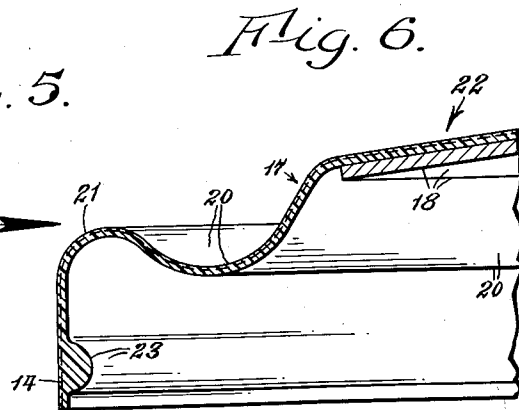
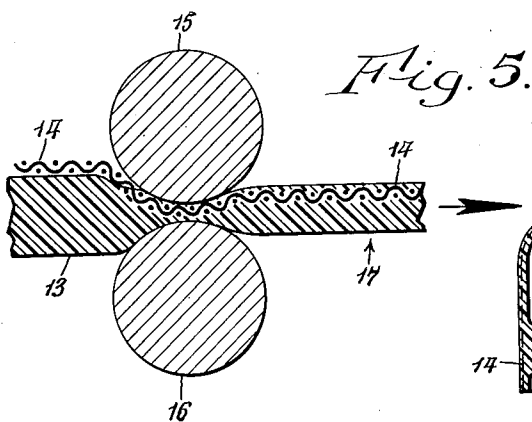
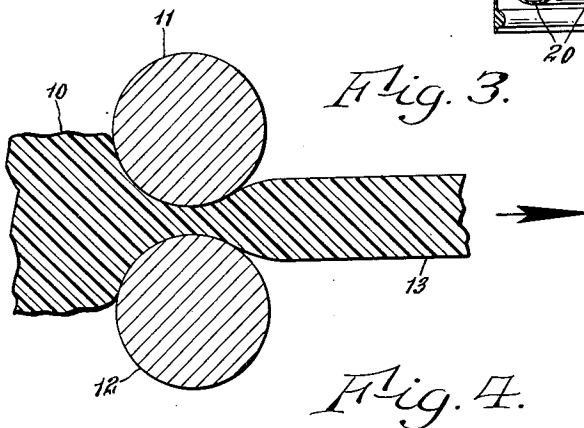
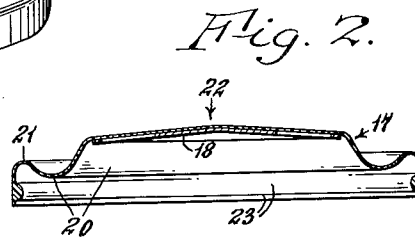
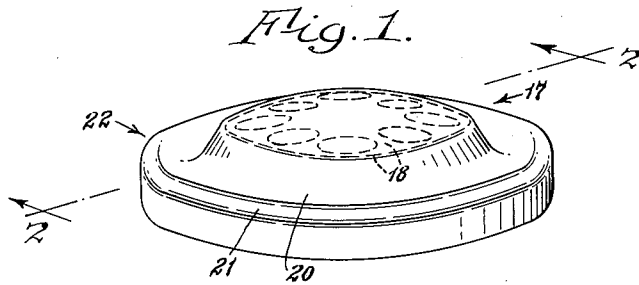
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PROCESS OF MAKING A DIAPHRAGM

Filed Nov. 4, 1955



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3,032,462

PROCESS OF MAKING A DIAPHRAGM

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This invention relates to a process for making diaphragms and more particularly to the making of that type of diaphragm which in its operation displaces a considerable volume of fluid. More especially the invention relates to a diaphragm comprising one component of a miniature regulator for a high altitude breathing apparatus employing oxygen as the breathing fluid.

The principal object of the invention is to provide a diaphragm which is very thin and sensitive and yet is able to function properly even when subjected to excessive pressures. Other collateral objects of the invention and practical attainments thereof are described in the following description and illustrated in the appended drawing, wherein:

FIG. 1 is a perspective view of the completed diaphragm.

FIG. 2 is a transverse medial section thereof, taken on line 2-2 FIG. 1.

FIG. 3 is an enlarged, schematic, fragmentary, transverse section illustrating the calendering of the rubber-like sheet which constitutes the chief component of the diaphragm.

FIG. 4 is an enlarged, fragmentary, transverse section thru a piece of fabric.

FIG. 5 is an enlarged, schematic, fragmentary, transverse section illustrating the calendering of the sheet and the fabric to form a "sandwich."

FIG. 6 is a somewhat enlarged, transverse, medial section thru the completed diaphragm.

For convenience and succinctness, this invention will be described exactly as illustrated but it is to be understood that the scope of the invention is to be measured by the rational interpretation of the claims.

The first step in the making of this diaphragm is to take a blob 10 of some such rubber-like material as silicone rubber and pass it between the rotating rolls 11 and 12 of a rubber calendering machine to form a silicone sheet 13. The blob of silicone rubber used in this calendering operation may be defined as hydrated magnesium silicate, $H_2Mg_3(SiO_3)_4$. The sheet 13 is approximately .030" thick and to obtain this thickness the rolls 11 and 12 are spaced approximately .010" apart.

This sheet 13 of silicone rubber is then overlaid by a strip of fabric 14 (as shown at the left side of FIG. 5) and this combination of silicone sheet 13 and superimposed fabric strip 14 is then fed thru rotating calendering rolls 15 and 16, which are spaced approximately .006" apart. The fabric is approximately .005" thick and the "sandwich" 17 that results from this second calendering operation is approximately .017" thick.

A conical, metal backing plate 18 now has its upper or convex side mechanically roughened by sandpaper or by sand blasting or the like and this surface then cleaned with acetone and a layer of silicone primer such as a silicone derivative primer applied. The sandwich 17 is then laid over said plate 18 and the whole laminated combination placed in a mold which is dusted with talcum powder to prevent the mold from sticking to the diaphragm. The mold is then compressed so as to shape the sandwich 17 to the diaphragm shape shown in FIG. 6 which shape includes the concentric annular convolutions or corrugations 20 and 21 and also the internal, annular, concentric rib 23. The mold is now heated to 240°-260° F. for 5 minutes. The mold is then opened

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and the diaphragm removed and its jagged peripheral edge trimmed off to form the finished diaphragm 22 of FIGS. 6, 1 and 2.

It should be noted that the metal plate 18 is bonded to that face of the "sandwich" 17 which is furthest from its fabric 14. This is to ensure maximum bonding strength between said plate 18 and the "sandwich" 17.

In some cases it is desirable to employ a fabric 14 which, while pliable, is not stretchable to any great extent, and in such cases it is desirable to use a fabric in which either the warp or the woof or of both the warp and the woof of the fabric, are of the tension-resisting type, as in ordinary woven cloth. In other cases, however, the volume of fluid displaced by the diaphragm and the fluid pressures involved are such that a certain amount of stretch of the diaphragm is desirable. In such cases it is preferable to use a fabric in which either the warp or the woof or of both the warp and the woof of the fabric are of the "knitted" type, i.e., of the type where there is a certain amount of "give" before the threads become straightened out. These threads may be of nylon, Orlon, Dacron or the like and in any certain application to be sufficiently strong to withstand fluid pressures which are sufficiently high to rupture the silicone if it were not reinforced by the fabric.

I claim:

1. The process of making an annular diaphragm consisting of producing a sheet of silicone rubber by calendering a quantity of silicone rubber between power-driven rolls; overlaying said sheet with a strip of raw fabric to form a sandwich; calendering said sheet-strip sandwich between a second pair of power-driven rolls which are spaced apart a considerably smaller distance than the thickness of said sheet-strip sandwich, and operate to very forcefully imbed said strip in said sheet; mechanically pressing said sheet-strip sandwich in a two-part, rigid, formed, diaphragm mold in a direction parallel to its axis; and then heating said sheet-strip sandwich to a temperature between 240° and 260° F.

2. As in claim 1 with a roughened backing-plate placed in the mold against one face of the sheet-strip sandwich, prior to the pressing and heating operations.

3. As in claim 1 with a roughened backing-plate placed in the mold against that particular face of the sheet-strip sandwich which is located the farthest from its strip, this latter placement being effected prior to the pressing and heating operations.

4. As in claim 1 with a silicone derivative primer applied to a backing-plate which latter is placed in the mold prior to the pressing and heating operations.

5. As in claim 1 with both the warp and woof of the fabric being of the knitted type.

6. As in claim 1 with the sheet of silicone rubber being approximately thirty thousandths of an inch thick.

7. As in claim 1 with the sheet of silicone rubber being approximately thirty thousandths thick and produced by the first calendering operation with the rolls spaced approximately ten thousandths of an inch apart.

8. As in claim 1 with the rolls of the first calendering operation being approximately thirty thousandths of an inch apart and the rolls of the second calendering operation being approximately six thousandths of an inch apart.

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